Spectral Invariant Approximation within Atmospheric Radiative Transfer; Applications to EarthCare

Certain algebraic combinations of single-scattering albedo and solar radiation reflected from, or transmitted through, vegetation canopies do not vary with wavelength. These "spectrally-invariant relationships" are the consequence of wavelength independence of the extinction coefficient and scattering phase function in vegetation. In general, this wavelength-independence does not hold in the atmosphere, but in cloud-dominated atmospheres the total extinction and total scattering phase function vary only weakly with wavelength. We identify the conditions under which the spectrally-invariant approximation can accurately describe the extinction and scattering properties of cloudy atmospheres. Validity of the assumptions and accuracy of the approximation is tested with radiative transfer calculations. We discuss the physics behind this phenomenon and possible applications to remote sensing, climate, and the EarthCare, mission in particular.